

(11) EP 1 440 673 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
03.09.2008 Bulletin 2008/36

(51) Int. Cl.:
A61F 2/84 (2006.01)

(21) Application number: 04001463.1

(22) Date of filing: 23.01.2004

(54) Stent-graft delivery system

Einführsystem für einen Stent-Graft

Système de pose d'un drain tuteur-grefon

(84) Designated Contracting States:
DE FR GB IE IT

• Elkins, Jeff
Novato
CA 94947 (US)

(30) Priority: 24.01.2003 US 351055

(43) Date of publication of application:
28.07.2004 Bulletin 2004/31

(74) Representative: Zimmermann, Gerd Heinrich et al
Zimmermann & Partner
Postfach 330 920
80069 München (DE)

(73) Proprietor: Medtronic Vascular, Inc.
Santa Rosa, CA 95403 (US)

(56) References cited:
EP-A- 1 097 728 EP-A- 1 212 989
WO-A-96/18361 WO-A-97/12563
WO-A-98/53761 US-A1- 2003 233 140

(72) Inventors:
• Goodson, Harry B.
Fremont
CA 94538 (US)

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to an intra-vascular device. More particularly, the present invention relates to a device for deployment of a stent-graft for treatment of intra-vascular aneurysms. Specifically, it relates to a stent-graft delivery system, a stent-graft retainment system.

[0002] In stent-graft deployment systems, a self-expanding stent-graft is restrained within a sheath. After placement of the stent-graft at the desired location via fluoroscopic guidance, the physician retracts the sheath to deploy the stent-graft, i.e., to expose the stent-graft and allow it to self-expand.

[0003] Document WO 98/53761 describes an introducer adapted for the introduction of a self-expanding endovascular prosthesis in a lumen of a patient. The introducer has attachment devices to hold each end of the prosthesis so that each can be moved independently. An endovascular prosthesis with stents at the proximal and distal ends being within the graft is also described. The remainder of the stents is positioned on the outside of the graft body.

[0004] However, prior to deployment, the compressed stent-graft tends to press outwards on the inner surface of the sheath because of its high radial force, self-expanding design. As a result, significant deployment force is required to retract the sheath to deploy the stent-graft.

[0005] This significant deployment force puts significant stress on the stent-graft, which can result in damage or destruction of the stent-graft during deployment. Further, this significant deployment force places significant stress on the delivery system, which can lead to component failure of the delivery system.

[0006] The present invention intends to overcome at least some of the above problems. The object is solved by the stent-graft delivery system according to independent claim 1.

[0007] Further advantages, features, aspects and details of the invention are evident from the dependent claims, the description and the drawings.

[0008] A method of delivering a stent-graft includes mounting the stent-graft on a pushrod; radially constraining the stent-graft within a sheath; securing a crown portion of the stent-graft to the pushrod with a retainer structure of a stent-graft retainment system; retracting the sheath to expose the crown portion of the stent-graft; and further retracting the sheath to cause the retainer structure to release the crown portion from the pushrod thus deploying the stent-graft.

[0009] The retainer structure releases the stent-graft automatically as a result of the retraction of the sheath. Thus, in accordance with an embodiment of the present invention, exposure of the crown portion of the stent-graft by retraction of the sheath is followed by release of the crown portion of the stent-graft by the retainer structure without requiring any additional manipulations by the physician compared to a conventional stent-graft delivery

system.

[0010] Since the retainer structure holds the crown portion against the pushrod during initial retraction of the sheath, the normal force exerted by the crown portion of the stent-graft against the sheath is minimized. Since this normal force is minimized, graft-to-sheath friction is minimized thus minimizing the stent-graft deployment (sheath retraction) force.

[0011] By minimizing the deployment force, the stress on the stent-graft is minimized thus minimizing the possibility of damaging the stent-graft during deployment. Further, by minimizing the deployment force, the stress on the stent-graft delivery system is minimized thus also minimizing the possibility of damaging the stent-graft delivery system during deployment of the stent-graft.

[0012] In the embodiment according to the present invention, a stent-graft delivery system includes: a pushrod having a lumen and a trigger aperture; a stent-graft retainment system having a retainer structure, and a retainer release trigger coupled to the retainer structure, the retainer release trigger including a trigger portion extending radially from the lumen through the trigger aperture; and a sheath having a trigger trip surface.

[0013] In another embodiment according to the present invention, a stent-graft retainment system includes: a retainer structure; and a retainer release trigger coupled to the retainer structure, the retainer release trigger having a pull rod portion coupled to a trigger portion.

[0014] A method of delivering a stent-graft includes mounting the stent-graft on a pushrod is described; radially constraining the stent-graft within a sheath; securing a crown portion of the stent-graft to the pushrod with a retainer structure of a stent-graft retainment system; retracting the sheath to expose the crown portion of the stent-graft; and further retracting the sheath to cause the retainer structure to release the crown portion from the pushrod thus deploying the stent-graft. The retainer structure releases the stent-graft automatically as a result of the retraction of the sheath.

[0015] The present invention is best understood by reference to the following detailed description when read in conjunction with the accompanying drawings.

Therein,

FIG. 1 is a modified partial cross-section view of a stent-graft delivery system within a parent vessel of a patient adjacent to a fistula aneurysm;

FIG. 2 is a modified partial cross-section view of the stent-graft delivery system of FIG. 1 during deployment of the stent-graft;

FIG. 3 is a modified partial cross-section view of the stent-graft delivery system of FIG. 2 at a further stage during deployment of the stent-graft;

FIG. 4 is a modified partial cross-section view of a region of a stent-graft delivery system;

FIG. 5 is a partial side view of a stent-graft delivery system having a crown portion of a stent-graft engaged with a stent-graft retainment system;

FIG. 6 is a side partial cross-section view of a region VI of the delivery system of FIG. 5;

FIG. 7 is a side partial cross-section view of the region VI of the delivery system of FIG. 6 during deployment of the stent-graft; and

FIGS. 8 and 9 are side partial cross-section views of a region of a stent-graft delivery system during deployment of a stent-graft.

[0016] Common reference numerals are used throughout the drawings and detailed description to indicate like elements.

[0017] A method of delivering a stent-graft 108 includes mounting stent-graft 108 on a pushrod 106 (FIG. 1); radially constraining stent-graft 108 within a sheath 112; securing a crown portion 118 of stent-graft 108 to pushrod 106 with a retainer structure 122 of a stent-graft retainment system 110; retracting sheath 112 to expose crown portion 118 of stent-graft 108 (FIG. 2); and further retracting sheath 112 to cause retainer structure 122 to release crown portion 118 from pushrod 106 thus deploying stent-graft 108 (FIG. 3).

[0018] Retainer structure 122 releases stent-graft 108 automatically as a result of the retraction of sheath 112. Thus, exposure of crown portion 118 by sheath 112 (FIG. 2) followed by release of crown portion 118 by retainer structure 122 (FIG. 3) does not require any additional manipulations by the physician compared to a conventional stent-graft delivery system.

[0019] More particularly, FIG. 1 is a modified partial cross-section view of a stent-graft delivery system 100 within a parent vessel 102 of a patient adjacent to a fistula aneurysm 104. Illustratively, fistula aneurysm 104 is an intra-cranial or aortic aneurysm although other aneurysms are treated in other embodiments.

[0020] Delivery system 100 includes a pushrod 106, a stent-graft 108, a stent-graft retainment system 110, a sheath 112, and a delivery handle 114.

[0021] In accordance with this embodiment, pushrod 106, sometimes called an inner catheter, is a hollow tubular member and includes a lumen 116, e.g., a guide wire lumen. In one embodiment (not shown), pushrod 106 includes an expandable catheter balloon for expanding and anchoring stent-graft 108 within parent vessel 102 as those of skill in the art will understand in light of this disclosure. However, for purposes of simplicity, stent-graft 108 is discussed below as being a self-expanding stent-graft.

[0022] Stent-graft 108 is placed over and mounted on pushrod 106. In one embodiment, pushrod 106 and/or stent-graft 108 include radiopaque markers, which allow the location of stent-graft 108 to be precisely tracked facilitating positioning of stent-graft 108 within parent vessel 102.

[0023] Stent-graft 108 is radially constrained by sheath 112. More particularly, prior to deployment, stent-graft 108 is located within sheath 112. Sheath 112 is coupled, e.g., with adhesive, to delivery handle 114.

[0024] Stent-graft 108 includes a crown portion 118, sometimes called a bare stent portion, at a proximal (upstream) end (with respect to an aortic deployment) of stent-graft 108. Stent-graft 108 further includes a stent-graft portion 120 coupled to crown portion 118.

[0025] Crown portion 118 of stent-graft 108 is secured to pushrod 106 by stent-graft retainment system 110. More particularly, crown portion 118 of stent-graft 108 is secured to pushrod 106 by a retainer structure 122, sometimes called a retainment means or means for retaining, of stent-graft retainment system 110.

[0026] Retainer structure 122 is a plurality of curved wires, sometimes called hooks, extending from lumen 116 through corresponding retainer apertures 124 of pushrod 106. Generally, retainer structure 122 includes at least one curved wire. Retainer structure 122 is formed of a rigid material, e.g., steel or spring steel, having a sufficient rigidity and strength to hold crown portion 118 of stent-graft 108 in place.

[0027] The plurality, e.g., two or more, of curved wires of retainer structure 122 are connected together by a trigger wire coupler 126 of stent-graft retainment system 110 at a proximal (downstream) end of retainer structure 122. The plurality of curved wires of retainer structure 122 extend distally (upstream) and outwards from trigger wire coupler 126. The plurality of curved wires of retainer structure 122 pass out from lumen 116 through corresponding retainer apertures 124 of pushrod 106 and curve to extend over crown portion 118 and back in the proximal (downstream) direction. However, in another embodiment (not shown), the plurality of wires of retainer structure 122 pass out from lumen 116 proximally (downstream) of crown portion 118 and extend over crown portion 118 in the distal (upstream) direction.

[0028] Stent-graft retainment system 110 further includes a retainer release trigger 128 coupled to retainer structure 122 by trigger wire coupler 126. Retainer release trigger 128, sometimes called a graft release trigger, is formed of a rigid material, e.g., a steel wire, having a sufficient rigidity and strength to cause retraction of retainer structure 122.

[0029] Although retainer structure 122 is illustrated and discussed above as being coupled to retainer release trigger 128 by trigger wire coupler 126, in another embodiment, retainer structure 122 and retainer release trigger 128 are integral, i.e., are a single piece not a plurality of separate pieces coupled together.

[0030] In the embodiment illustrated in FIG. 1, retainer release trigger 128 comprises a pull rod portion 130 and a trigger portion 132 coupled together at a bend portion 134. In this embodiment, pull rod portion 130, trigger portion 132 and bend portion 134 are integral, but can be separate pieces connected together in another embodiment.

[0031] A distal (upstream) end of pull rod portion 130 is coupled to trigger wire coupler 126. Pull rod portion 130 extends longitudinally in the proximal direction from trigger wire coupler 126 through lumen 116 of pushrod

106. Pull rod portion 130 is coupled to trigger portion 132 at a proximal (downstream) end of pull rod portion 130.

[0032] Generally, pull rod portion 130 extends along the length of longitudinal axis L of pushrod 106 and thus pull rod portion 130 is sometimes said to extend longitudinally or in the longitudinal direction. Trigger portion 132 extends in a direction perpendicular to longitudinal axis L of pushrod 106 and thus trigger portion 132 is sometimes said to extend radially or in the radial direction. Bend portion 134 bends from the longitudinal direction to the radial direction.

[0033] Pushrod 106 further comprises a trigger aperture 138. In this embodiment, trigger aperture 138 is a longitudinal slot in pushrod 106. Trigger portion 132 extends radially from lumen 116 of pushrod 106 and through trigger aperture 138. Trigger portion 132 extends radially outwards from pushrod 106 a radial distance TP, sometimes called a first radial distance. The radial distance S, sometimes called a second radial distance, between sheath 112 and pushrod 106 is less than the distance TP of trigger portion 132. Thus, sheath 112 contacts trigger portion 132 during retraction. Pull rod portion 130 is positioned within pushrod 106, for example, by splitting and rejoining the radial sections of pushrod 106. A separate lumen within pushrod 106 guides the motion of pull rod portion 130 in one embodiment.

[0034] However, to prevent trigger portion 132 from contacting delivery handle 114, the radial distance DH, sometimes called a third radial distance, between delivery handle 114 and pushrod 106 is greater than the distance TP of trigger portion 132. This allows delivery handle 114 to be moved without contacting trigger portion 132 as discussed in greater detail below.

[0035] More particularly, sheath 112 comprises an annular trigger trip surface 140, which is perpendicular to longitudinal axis L of pushrod 106. Trigger trip surface 140 is located at the proximal (downstream) end of sheath 112 and extends between an inner surface 142 and an outer surface 144 of sheath 112. Prior to retraction of sheath 112, a longitudinal trigger trip distance TTD exists between trigger trip surface 140 and trigger portion 132. Although trigger trip surface 140 is discussed and illustrated herein as being a surface of sheath 112, in an alternative embodiment (not shown), trigger trip surface 140 is a surface of a different element of delivery system 100, e.g., of delivery handle 114.

[0036] FIG. 2 is a modified partial cross-section view of stent-graft delivery system 100 during deployment of stent-graft 108. Referring now to FIGS. 1 and 2 together, to deploy stent-graft 108, delivery handle 114 is retracted. Since sheath 112 is coupled to delivery handle 114, retraction of delivery handle 114 causes retraction of sheath 112.

[0037] Since retainer structure 122 holds crown portion 118 against pushrod 106, the large normal force which would otherwise be exerted by crown portion 118 of stent-graft 108 against inner surface 142 of sheath 112 is minimized. Since the normal force is minimized, graft-

to-sheath friction is minimized thus minimizing the deployment force, i.e., the force exerted upon delivery handle 114 during retraction. In addition, a reduction in the normal force minimizes any embedding (mechanical engagement) of stent-graft 108 into sheath 112, which further minimizes the deployment force.

[0038] By minimizing the deployment force, the stress on stent-graft 108 is minimized thus minimizing the possibility of damaging stent-graft 108 during deployment. Further, by minimizing the deployment force, the stress on delivery system 100 is minimized thus also minimizing the possibility of damaging delivery system 100 during deployment of stent-graft 108. For example, stretching of sheath 112 and the associated possibility of necking of sheath 112 (diameter reduction) and/or failures at bonds between components, e.g., between sheath 112 and delivery handle 114, are minimized by minimizing the deployment force.

[0039] Further, stent-graft 108 is placed in tension rather than compression during deployment. More particularly, stent graft 108 is pulled proximally (downstream) from crown portion 118 and retainer structure 122 by sheath 112 during deployment. This minimizes the possibility of bunching of stent-graft 108.

[0040] After delivery handle 114 and the sheath 112 are retracted, i.e., moved, trigger trip distance TTD, sheath 112 contacts trigger portion 132 as shown in FIG. 2. More particularly, trigger trip surface 140 contacts trigger portion 132 and thus further retraction of delivery handle 114 and sheath 112 causes an equal retraction of trigger portion 132.

[0041] FIG. 3 is a modified partial cross-section view of stent-graft delivery system 100 of FIG. 2 at a further stage during deployment of stent-graft 108. Referring now to FIGS. 2 and 3 together, further retraction of delivery handle 114 and sheath 112 causes retraction of trigger portion 132 and release of crown portion 118 of stent-graft 108.

[0042] More particularly, retraction of trigger portion 132 causes proximal (downstream towards delivery handle 114) longitudinal motion of pull rod portion 130. This, in turn, causes proximal longitudinal motion of trigger wire coupler 126 and retraction of the plurality of curved wires of retainer structure 122, i.e., causes retraction of retainer structure 122, into pushrod 106.

[0043] As retainer structure 122 is retracted to expose crown portion 118, crown portion 118 is released from pushrod 106 by retainer structure 122. Since sheath 112 has also been retracted to expose crown portion 118, crown portion 118 self-expands into contact with parent vessel 102. Further retraction of delivery handle 114 and sheath 112 completes deployment of stent-graft 108.

[0044] As discussed above, retainer structure 122 releases stent-graft 108 automatically during retraction of delivery handle 114. Thus, use of stent-graft delivery system 100 including stent-graft retention system 110 does not require any additional operations (manipulation) by the physician compared to a conventional stent-graft

delivery system.

[0045] Further, referring again to FIG. 1, trigger trip distance TTD controls how much of stent-graft 108 is exposed by sheath 112 prior to release by retainer structure 122. Accordingly, by appropriately defining trigger trip distance TTD, stent-graft 108 is released after a desired amount of stent-graft 108 is exposed by sheath 112.

[0046] For example, stent-graft 108 is released after sheath 112 has uncovered and exposed the first few stent rings, e.g., crown portion 118 and the most proximal 2 to 4 stent rings, of stent-graft 108. Crown portion 118 and the first few stent rings of stent-graft 108 cause the highest normal friction and associated deployment force. Thus, by restraining crown portion 118 against pushrod 106 by retainer structure 122 during retraction of sheath 112 over the first few stent rings, a significant benefit is obtained. Further, this allows the physician to uncover the first stent rings and assess the position of stent-graft 108 in parent vessel 102 before releasing crown portion 118 and sealing the stent-graft 108 in parent vessel 102.

[0047] FIG. 4 is a modified partial cross-section view of a region of a stent-graft delivery system 100A of another embodiment according to the present invention. Retainer release trigger 128A of stent-graft retainment system 110A of stent-graft delivery system 100A includes a locking feature 402, sometimes called a locking means, for securing trigger portion 132 to sheath 112.

[0048] More particularly, locking feature 402 and trigger portion 132 are coupled together at a bend portion 404. In this configuration, trigger portion 132, locking feature 402, and bend portion 404 are integral, but can be separate pieces connected together in another embodiment.

[0049] A proximal (downstream) end of locking feature 402 is coupled to trigger portion 132 by bend portion 404. Locking feature 402 extends in the distal (upstream) direction from trigger portion 132.

[0050] When trigger portion 132 is engaged with trigger trip surface 140 of sheath 112 as illustrated in FIG. 4, locking feature 402 is adjacent to outer surface 144 of sheath 112. This locks retainer release trigger 128A around the proximal end of sheath 112 thus ensuring that retainer release trigger 128A does not slip from sheath 112. Delivery handle 114 is configured to accommodate the positioning of locking feature 402, e.g., by providing a space 406 between delivery handle 114 and outer surface 144 of sheath 112.

[0051] FIG. 5 is a partial side view of a stent-graft delivery system 100B having crown portion 118 of stent-graft 108 engaged with a stent-graft retainment system 110B of another embodiment according to the present invention. Delivery system 100B is similar to delivery system 100 of FIGS. 1, 2, and 3 and so various elements, e.g., sheath 112, are not illustrated in FIG. 5. FIG. 6 is a side partial cross-section view of a region VI of delivery system 100B of FIG. 5.

[0052] Referring now to FIGS. 5 and 6 together, pushrod 106A comprises at least one trench 500 extending

partially or completely around the circumference of pushrod 106A. Further, a retainer structure 122A comprises straight wires 502 (only a wire 502 and a wire 502A of the plurality of wires 502 are illustrated in FIG. 5) extending across trench 500 of pushrod 106A. Generally, retainer structure 122A includes at least one wire 502.

[0053] More particularly, trench 500 is defined by a proximal (partial or full) annular surface 504, e.g., at least one proximal annular surface, a distal (partial or full) annular surface 506, e.g., at least one distal annular surface, and a longitudinal (partial or full) ring surface 508, e.g., at least one longitudinal ring surface. In this embodiment, proximal annular surface 504 and distal annular surface 506 are perpendicular to longitudinal axis L of pushrod 106A. Further, longitudinal ring surface 508 is parallel to longitudinal axis L of pushrod 106A.

[0054] Proximal annular surface 504 and distal annular surface 506 includes proximal retainer apertures 510 (only a proximal retainer aperture 510 and a proximal retainer aperture 510A of the plurality of proximal retainer apertures 510 are illustrated in FIG. 5) and corresponding distal retainer apertures 512 (only a distal retainer aperture 512 and a distal retainer aperture 512A of the plurality of distal retainer apertures 512 are illustrated in FIG. 5), respectively. Wires 502 extend distally from pushrod 106A through proximal retainer apertures 510, longitudinally across trench 500, and back into pushrod 106A through distal retainer apertures 512.

[0055] To illustrate, a first wire 502A of the plurality of wires 502 extends distally from pushrod 106A through a first proximal retainer aperture 510A of the plurality of proximal retainer apertures 510, longitudinally across trench 500, and back into pushrod 106A through a first distal retainer aperture 512A of the plurality of distal retainer apertures 512 as shown in FIGS. 5 and 6.

[0056] FIG. 7 is a side partial cross-section view of region VI of delivery system 100B of FIG. 6 during deployment of stent-graft 108.

[0057] Referring now to FIGS. 5, 6, and 7 together, proximal annular surface 504, distal annular surface 506, longitudinal ring surface 508 and wires 502 define pockets 514 (only a pocket 514 and a pocket 514A of the plurality of pockets 514 are illustrated in FIGS. 5, 6, 7). Prior to deployment of stent-graft 108, crown portion 118 is retained within pockets 514.

[0058] To illustrate, proximal annular surface 504, distal annular surface 506, longitudinal ring surface 508 and wire 502A define a first pocket 514A of the plurality of pockets 514. A loop 516 of crown portion 118 passes through pocket 514A and presses radially outwards on wire 502A.

[0059] To deploy stent-graft 108, trigger wire coupler 126 is retracted as discussed above in reference to FIGS. 2 and 3. This causes retraction of wires 502 of retainer structure 122A. More particularly, wires 502 are retracted out of distal retainer apertures 512 and into proximal retainer apertures 510. Stated another way, wires 502 are retracted thus opening pockets 514. This releases crown

portion 118 of stent-graft 108 resulting in deployment of stent-graft 108 as shown in FIG. 7.

[0060] In another embodiment, direct contact between crown portion 118 and retractable wires 502 is avoided. FIGS. 8 and 9 are side partial cross-section views of a region of a stent-graft delivery system 100C during deployment of stent-graft 108 according to another embodiment of the present invention.

[0061] Referring now to FIGS. 8 and 9 together, swings 800 are pivotally attached to distal annular surface 506 and extend across localized portions of trench 500. The number of swings 800 corresponds to the number of wires 502 around pushrod 106A. As shown in FIG. 8, crown portion 118 presses upon swings 800 which, in turn, press upon wires 502.

[0062] To deploy stent-graft 108, wires 502 are retracted as discussed above. More particularly, wires 502 are retracted out of distal retainer apertures 512 and into proximal retainer apertures 510. Stated another way, wires 502 are retracted thus opening pockets 514. This releases swings 800, which pivot from distal annular surface 506. This, in turn, releases crown portion 118 of stent-graft 108 resulting in deployment of stent-graft 108 as shown in FIG. 9.

[0063] In one embodiment, the coefficient of friction between swings 800 and wires 502 is less than the coefficient of friction between crown portion 118 and wires 502. Accordingly, use of swings 800 minimizes deployment force.

[0064] This disclosure provides exemplary embodiments of the present invention. The scope of the present invention is not limited by these exemplary embodiments. Numerous variations, whether explicitly provided for by the specification or implied by the specification or not, such as variations in structure, dimension, type of material and manufacturing process may be implemented by one of skill in the art in view of this disclosure.

Claims

1. A stent-graft delivery system comprising:

a pushrod (106; 106A) comprising:

a lumen; and
a trigger aperture (124);

a stent-graft retainment system (110; 110B) comprising:

a retainer structure (122, 122A) for holding a crown portion (118) of a stent graft (108) in place; and

a retainer release trigger (128; 128A) coupled to said retainer structure, said retainer release trigger comprising a trigger portion (132) extending radially from said lumen

through said trigger aperture; and

a sheath (112) comprising a trigger trip surface (140) configured to contact said trigger portion (132) upon retraction of said sheath about a trigger trip distance, wherein said retainer release trigger is adapted to cause retraction of the retainer structure (122) upon further retraction of the sheath.

2. The stent-graft delivery system of Claim 1 wherein a longitudinal trigger trip distance exists between said trigger trip surface and said trigger portion prior to retraction of said sheath.

3. The stent-graft delivery system of any of the preceding claims wherein said trigger portion extends radially outwards from said pushrod a first radial distance, and wherein a second radial distance exists between said pushrod and said sheath, said first radial distance being greater than said second radial distance.

4. The stent-graft delivery system of Claim 3 wherein said trigger trip surface contacts said trigger portion during retraction of said sheath.

5. The stent-graft delivery system of any of the preceding claims wherein said retainer release trigger further comprises a pull rod portion (130) coupled to said trigger portion, said pull rod portion extending longitudinally through said lumen.

6. The stent-graft delivery system of Claim 5 wherein said retainer release trigger (128; 128A) further comprises a locking feature (402) coupled to said trigger portion.

7. The stent-graft delivery system of Claim 6 wherein said locking feature secures said trigger portion to said sheath during use of said stent-graft delivery system.

8. The stent-graft delivery system of any of the preceding claims wherein said retainer structure comprises at least one hook extending from said lumen through at least one corresponding retainer aperture of said pushrod.

9. The stent-graft delivery system of Claim 8 wherein a proximal end of said retainer structure (122; 122A) is coupled to said retainer release trigger (128; 128A) by a trigger wire coupler (126).

10. The stent-graft delivery system of any of claims 8 to 9 wherein said at least one hook extends distally from said trigger wire coupler through said at least one corresponding retainer aperture and curves to

extend back in the proximal direction.

11. The stent-graft delivery system of any of claims 8 to 10 further comprising a stent-graft, wherein said at least one hook extends over a portion of said stent-graft (108). 5
12. The stent-graft delivery system of Claim 11 wherein said portion of said stent-graft comprises a crown portion (118) of said stent-graft. 10
13. The stent-graft delivery system of any of claims 11 to 12 wherein said at least one hook secures said portion of said stent-graft to said pushrod. 15
14. The stent-graft delivery system of any of claims 1 to 13 wherein said sheath (112) radially constrains said stent-graft. 20
15. The stent-graft delivery system of any of claims 1 to 14 wherein said pushrod (106; 106A) comprises at least one trench (500) defined by at least one proximal annular surface, at least one distal annular surface, and at least one longitudinal ring surface of said pushrod, said retainer structure comprising at least one wire extending across said at least one trench. 25
16. The stent-graft delivery system of Claim 15 wherein said at least one wire extends distally from said pushrod through a proximal retainer aperture in said at least one proximal annular surface, across said at least one trench, and back into said pushrod through a distal retainer aperture of said at least one distal annular surface. 30
17. The stent-graft delivery system of any of claims 15 to 16 wherein said at least one proximal annular surface, said at least one distal annular surface, said at least one longitudinal ring surface and said at least one wire define at least one pocket, said stent-graft delivery system further comprising a stent-graft comprising a portion located in said at least one pocket. 35
18. The stent-graft delivery system of any of claims 15 to 17 further comprising at least one swing pivotally attached to said at least one distal annular surface. 40

Patentansprüche

1. Stenttransplantat-Zubringungssystem, umfassend:

eine Schubstange (106, 106A), umfassend:

ein Lumen; und
eine Auslöseröffnung (124);
ein Stenttransplantat-Haltesystem (110);

110B), umfassend:

eine Halterungskonstruktion (122, 122A) zum Halten eines Kopfabchnitts (118) eines Stenttransplantats (108) an seinem Platz; und einen Halterungsfreigabeauslöser (128, 128A), welcher mit der Halterungskonstruktion gekoppelt ist, wobei der Halterungsfreigabeauslöser einen Auslöserabschnitt (132) umfasst, welcher sich radial von dem Lumen durch die Auslöseröffnung erstreckt; und eine Hülle (112), welche eine Auslöseranschlagsfläche (140) umfasst, welche so gestaltet ist, dass sie den Auslöserabschnitt (132) nach Zurückziehen der Hülle um einen Auslöseranschlagsabstand berührt, wobei der Halterungsfreigabeauslöser dafür eingerichtet ist, das Zurückziehen der Halterungskonstruktion (122) nach weiterem Zurückziehen der Hülle zu bewirken.

2. Stenttransplantat-Zubringungssystem nach Anspruch 1, wobei vor dem Zurückziehen der Hülle ein longitudinaler Auslöseranschlagsabstand zwischen der Auslöseranschlagsfläche und dem Auslöserabschnitt besteht.
3. Stenttransplantat-Zubringungssystem nach einem der vorangegangenen Ansprüche, wobei sich der Auslöserabschnitt um einen ersten radialen Abstand von der Schubstange radial nach außen erstreckt und wobei ein zweiter radialer Abstand zwischen der Schubstange und der Hülle besteht, wobei der erste radiale Abstand größer als der zweite radiale Abstand ist.
4. Stenttransplantat-Zubringungssystem nach Anspruch 3, wobei die Auslöseranschlagsfläche den Auslöserabschnitt während des Zurückziehens der Hülle berührt.
5. Stenttransplantat-Zubringungssystem nach einem der vorangegangenen Ansprüche, wobei der Halterungsfreigabeauslöser weiterhin einen Schubstangenabschnitt (130) umfasst, welcher mit dem Auslöserabschnitt gekoppelt ist, wobei der Schubstangenabschnitt sich längs durch das Lumen erstreckt.
6. Stenttransplantat-Zubringungssystem nach Anspruch 5, wobei der Halterungsfreigabeauslöser (128; 128A) weiterhin eine Verriegelungseinrichtung (402) umfasst, welche mit dem Auslöserabschnitt gekoppelt ist.
7. Stenttransplantat-Zubringungssystem nach An-

spruch 6, wobei die Verriegelungseinrichtung den Auslöserabschnitt während der Anwendung des Stenttransplantat-Zubringungssystems an der Hülle sichert.

8. Stenttransplantat-Zubringungssystem nach einem der vorangegangenen Ansprüche, wobei die Halterungskonstruktion wenigstens einen Haken umfasst, welcher sich von dem Lumen durch wenigstens eine zugehörige Halterungsöffnung der Schubstange erstreckt.

9. Stenttransplantat-Zubringungssystem nach Anspruch 8, wobei ein proximales Ende der Halterungskonstruktion (122; 122A) mit dem Halterungsfreigabeauslöser (128; 128A) durch einen Auslöserdrahtkoppler (126) gekoppelt ist.

10. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 8 bis 9, wobei sich der wenigstens eine Haken von dem Auslöserdrahtkoppler distal durch die wenigstens eine zugehörige Halterungsöffnung erstreckt und sich so biegt, daß er sich in die proximale Richtung zurück erstreckt.

11. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 8 bis 10, welches weiterhin ein Stenttransplantat umfasst, wobei sich der wenigstens eine Haken über einen Abschnitt des Stenttransplantats erstreckt (108).

12. Stenttransplantat-Zubringungssystem nach Anspruch 11, wobei der Abschnitt des Stenttransplantats einen Kopfabschnitt (118) des Stenttransplantats umfasst.

13. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 11 bis 12, wobei der wenigstens eine Haken den Abschnitt des Stenttransplantats an der Schubstange sichert.

14. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 1 bis 13, wobei die Hülle (112) das Stenttransplantat radial begrenzt.

15. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 1 bis 14, wobei die Schubstange (106; 106A) wenigstens einen Einschnitt (500) umfasst, welcher durch wenigstens eine proximale ringförmige Fläche, wenigstens eine distale ringförmige Fläche und wenigstens eine längs verlaufende Ringfläche der Schubstange definiert ist, wobei die Halterungskonstruktion wenigstens einen Draht umfasst, der sich über den wenigstens einen Einschnitt erstreckt.

16. Stenttransplantat-Zubringungssystem nach Anspruch 15, wobei sich der wenigstens eine Draht distal von der Schubstange durch eine proximale Halterungsöffnung in der wenigstens einen proximalen ringförmigen Fläche, über den wenigstens einen Einschnitt, und zurück in die Schubstange durch eine distale Halterungsöffnung der wenigstens einen distalen ringförmigen Fläche erstreckt.

17. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 15 bis 16, wobei die wenigstens eine proximale ringförmige Fläche, die wenigstens eine distale ringförmige Fläche, die wenigstens eine längs verlaufende Ringfläche und der wenigstens eine Draht wenigstens eine Aussparung definieren, wobei das Stenttransplantat-Zubringungssystem weiterhin ein Stenttransplantat umfasst, welches einen Abschnitt umfasst, der in der wenigstens einen Aussparung angeordnet ist.

18. Stenttransplantat-Zubringungssystem nach einem der Ansprüche 15 bis 17, welches weiterhin wenigstens eine Klappe umfasst, welche schwenkbar an der wenigstens einen distalen ringförmigen Fläche angebracht ist.

Revendications

1. Système de distribution d'un drain tuteur-greffon, comprenant :

une tige poussoir (106 ; 106A) comprenant :

une lumière ; et
une ouverture (124) pour gâchette ;

un système de retenue (110 ; 110B) du drain tuteur-greffon comprenant :

une structure de retenue (122, 122A) pour retenir en place une portion en couronne (118) d'un drain tuteur-greffon (108) ; et
une gâchette de libération (128 ; 128A) couplée à ladite structure de retenue,

ladite gâchette de libération comprenant une portion formant gâchette (132) s'étendant radialement depuis ladite lumière au travers de ladite ouverture pour gâchette ; et
un manchon (112) comprenant une surface (140) de détente configurée pour venir en contact avec ladite portion formant gâchette (132) lors du retrait dudit manchon sur une distance de détente, la gâchette de libération étant adaptée à provoquer le retrait de la structure de retenue (122) lors d'un retrait supplémentaire du manchon.

2. Système de distribution d'un drain tuteur-greffon se-

ion la revendication 1, dans lequel il existe une distance longitudinale de détente entre ladite surface de détente et ladite portion formant gâchette avant le retrait dudit manchon.

3. Système de distribution d'un drain tuteur-greffon selon l'une quelconque des revendications précédentes, dans lequel ladite portion formant gâchette s'étend radialement vers l'extérieur depuis ladite tige poussoir sur une première distance radiale et dans lequel existe une seconde distance radiale entre ladite tige poussoir et ledit manchon, ladite première distance radiale étant supérieure à ladite seconde distance radiale.
4. Système de distribution d'un drain tuteur-greffon selon la revendication 3, dans lequel ladite surface de détente vient en contact avec ladite portion formant gâchette au cours du retrait dudit manchon.
5. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications précédentes, dans lequel ladite gâchette de libération comprend, en outre, une portion (130) formant tige poussoir couplée à ladite portion formant gâchette, ladite portion formant tige poussoir s'étendant longitudinalement dans ladite lumière.
6. Système de distribution de drain tuteur-greffon selon la revendication 5, dans lequel ladite gâchette de libération (128 ; 128A) comprend, en outre, une caractéristique de verrouillage (402) couplée à ladite portion formant gâchette.
7. Système de distribution de drain tuteur-greffon selon la revendication 6, dans lequel ladite caractéristique de verrouillage réunit ladite portion formant gâchette audit manchon pendant l'utilisation dudit système de distribution de drain tuteur-greffon.
8. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications précédentes, dans lequel ladite structure de retenue comprend au moins un crochet qui s'étend depuis ladite lumière via au moins une ouverture correspondante de retenue ménagée dans ladite tige poussoir.
9. Système de distribution de drain tuteur-greffon selon la revendication 8, dans lequel une extrémité proximale de ladite structure de retenue (122 ; 122A) est couplée à ladite gâchette de libération (128 ; 128A) par un coupleur de fil de détente (126).
10. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 8 ou 9, dans lequel ledit au moins un crochet s'étend dans une direction distale par rapport audit coupleur de fil de détente, via ladite au moins une ouverture corres-

pondante de retenue, et se courbe pour revenir dans la direction proximale.

11. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 8 à 10, comprenant, en outre, un drain tuteur-greffon, système dans lequel ledit au moins un crochet s'étend sur une portion dudit drain tuteur-greffon (108).
12. Système de distribution de drain tuteur-greffon selon la revendication 11, dans lequel ladite portion dudit drain tuteur-greffon comprend une portion en couronne (118) dudit drain tuteur-greffon.
13. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 11 à 12, dans lequel ledit au moins un crochet réunit ladite portion dudit drain tuteur-greffon à ladite tige poussoir.
14. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 1 à 13, dans lequel ledit manchon (112) exerce une contrainte radiale sur ledit drain tuteur-greffon.
15. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 1 à 14, dans lequel ladite tige poussoir (106 ; 106A) comprend au moins une gorge (500) définie par au moins une surface annulaire proximale, au moins une surface annulaire distale et au moins une surface cylindrique longitudinale de ladite tige poussoir ; ladite structure de retenue comprenant au moins un fil s'étendant d'un côté à l'autre de ladite au moins une gorge.
16. Système de distribution de drain tuteur-greffon selon la revendication 15, dans lequel ledit au moins un fil s'étend dans une direction distale par rapport à ladite tige poussoir via une ouverture de retenue proximale ménagée dans ladite au moins une surface annulaire proximale, d'un côté à l'autre de ladite au moins une gorge, et en retour dans ladite tige poussoir via une ouverture de retenue distale ménagée dans ladite au moins une surface annulaire distale.
17. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 15 ou 16, dans lequel ladite au moins une surface annulaire proximale, ladite au moins une surface annulaire distale, ladite au moins une surface cylindrique longitudinale et ledit au moins un fil définissent au moins une poche, ledit système de distribution de drain tuteur-greffon comprenant, en outre, un drain tuteur-greffon dont une portion est située dans ladite au moins une poche.
18. Système de distribution de drain tuteur-greffon selon l'une quelconque des revendications 15 à 17, comprenant, en outre, au moins un doigt monté pivotant

sur ladite au moins une surface annulaire distale.

5

10

15

20

25

30

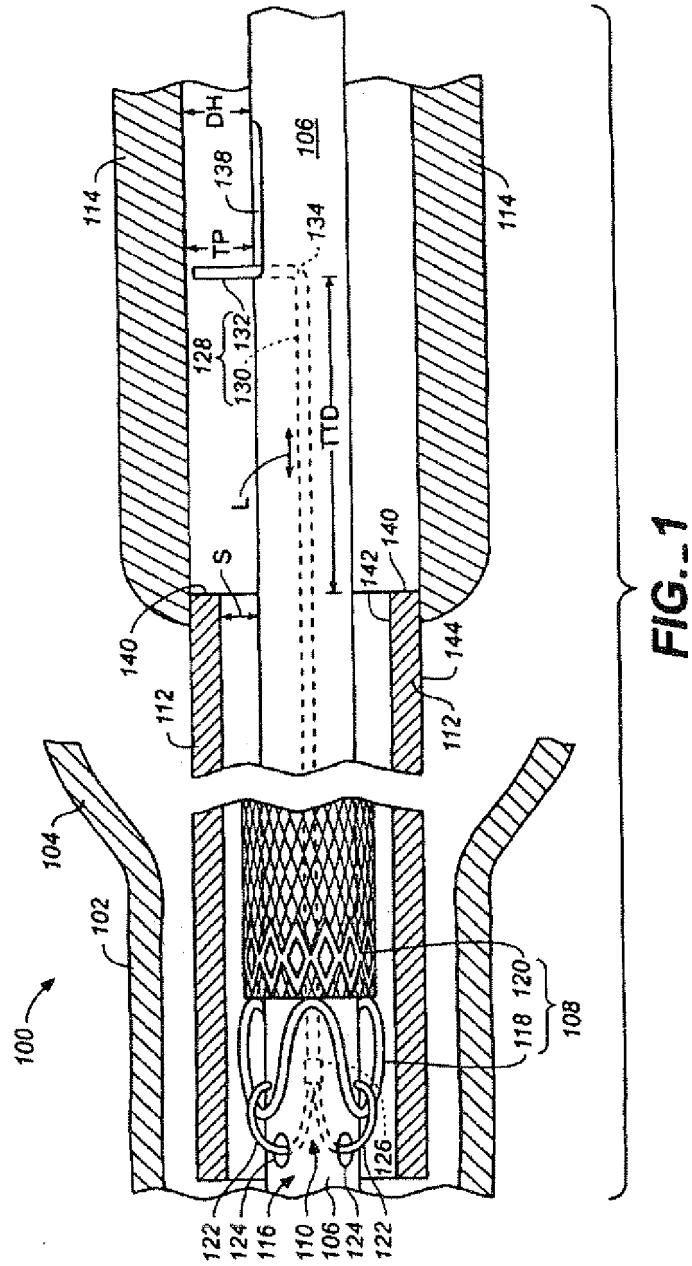
35

40

45

50

55



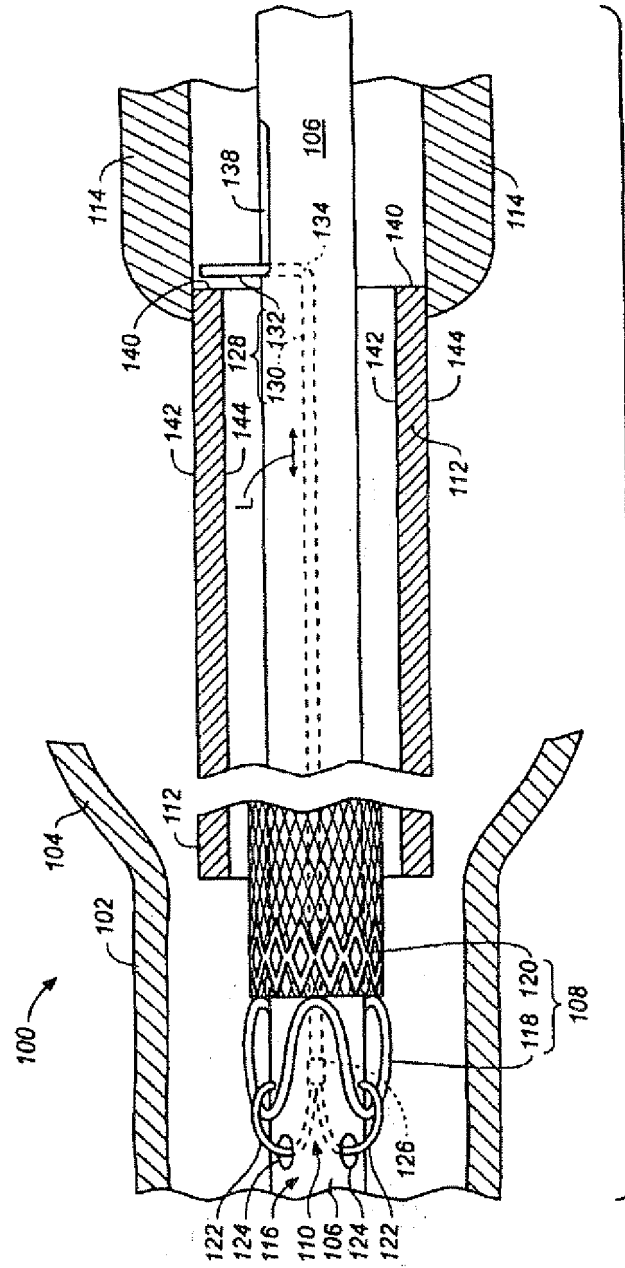
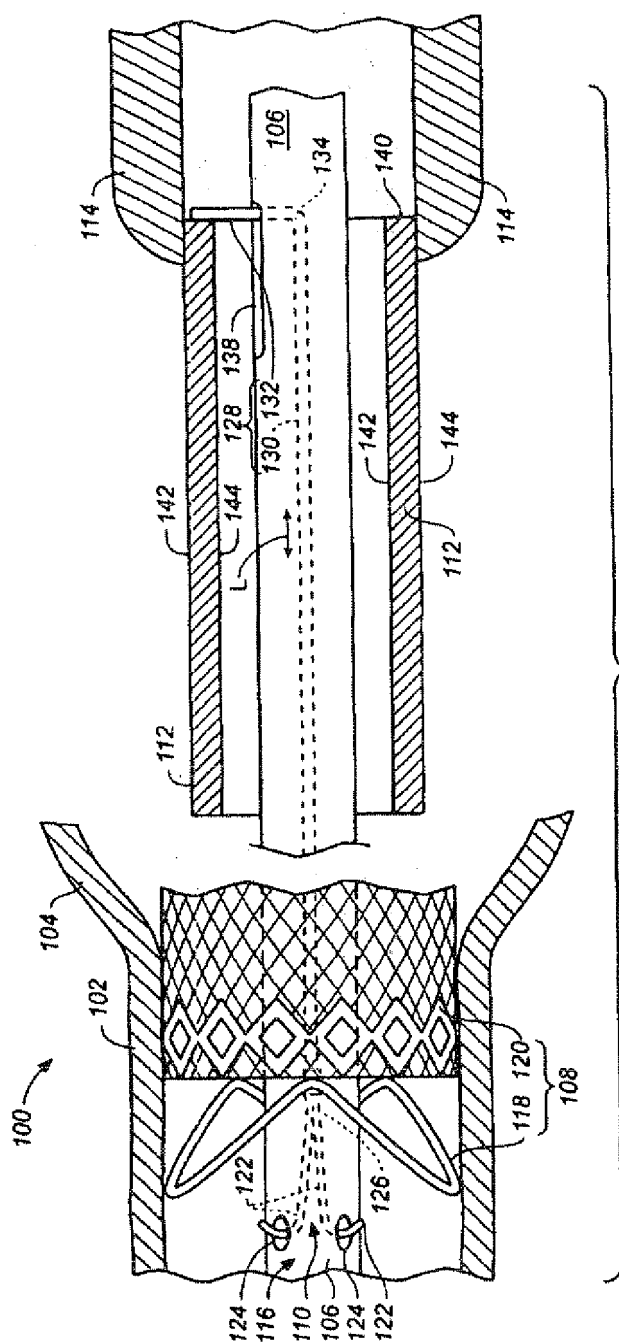


FIG. 2



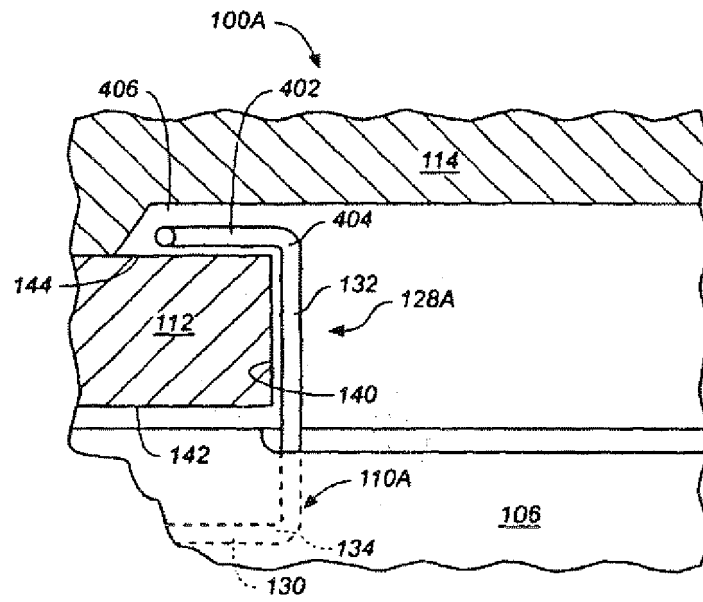


FIG. 4

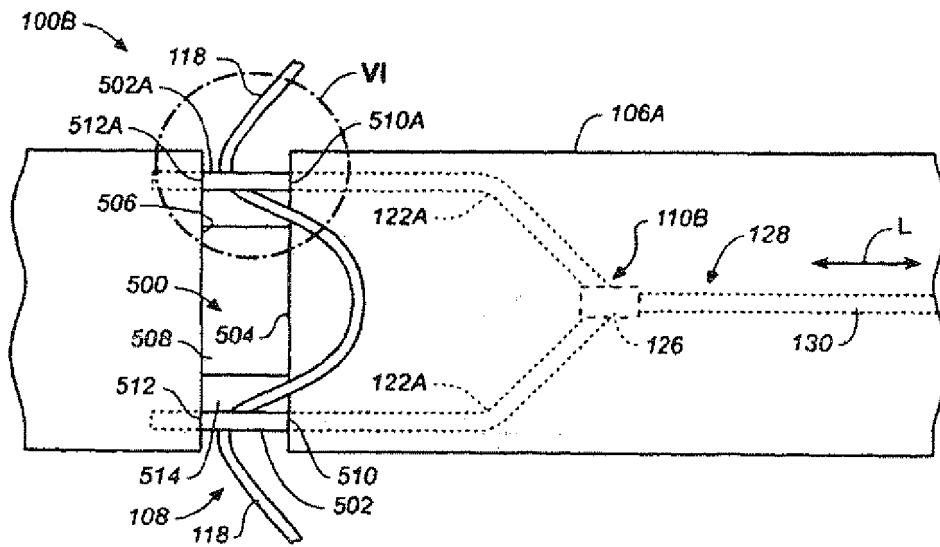
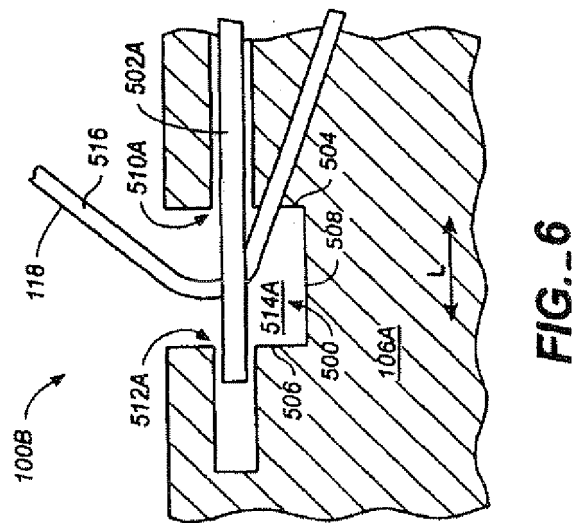
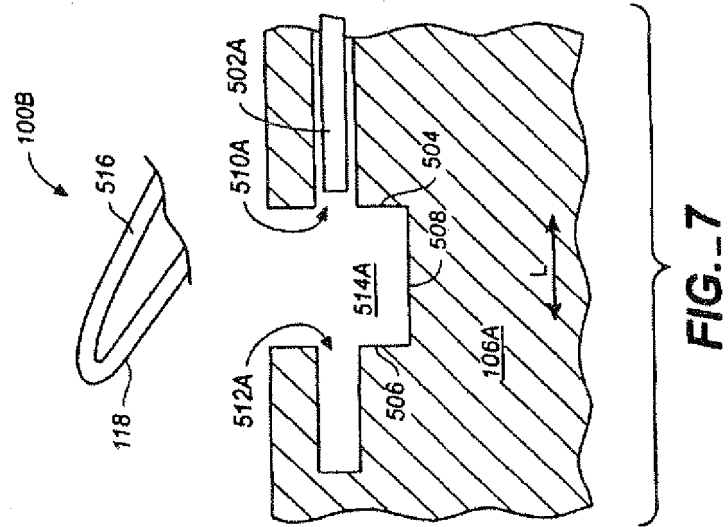
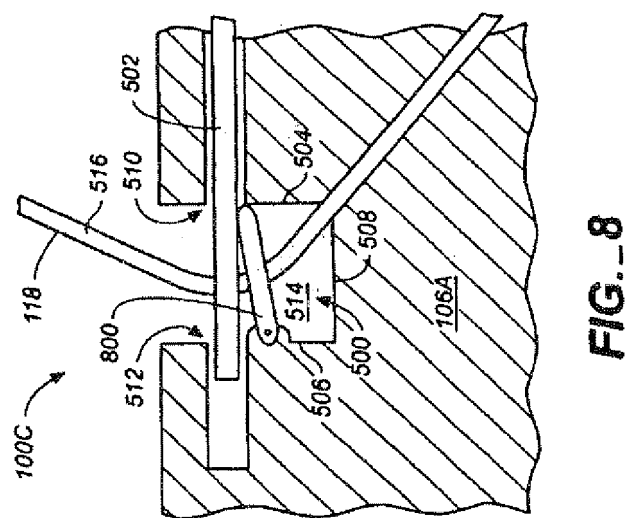
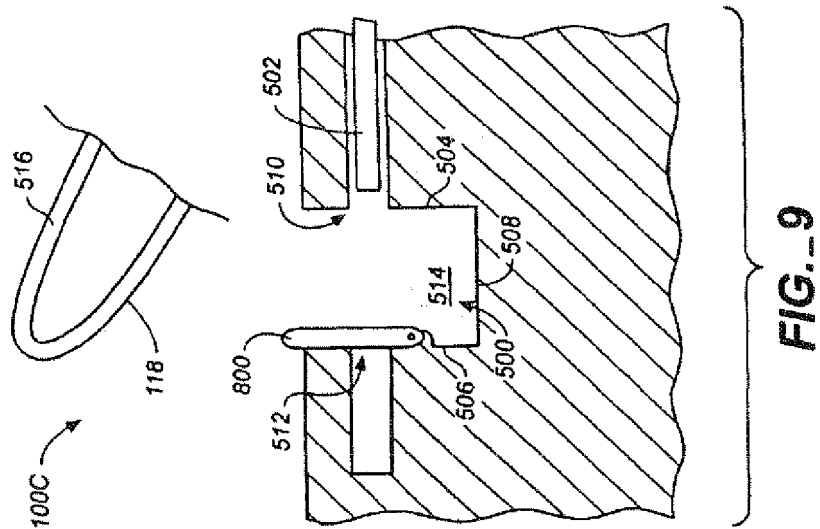


FIG. 5





REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 9853761 A [0003]